

A Cognitive Account of Situated Communication

Rita B. Arditò (ardito@psych.unito.it)
Bruno G. Bara (bara@psych.unito.it)
Enrico Blanzieri (blanzieri@psych.unito.it)

Centro di Scienza Cognitiva, Università di Torino
via Po 14, 10123 Torino, Italy

Abstract

Communication is situated and it is situated in the environment, in the perception the participants have of the environment, and also in the mental representations they privately retain. This work addresses the problem of explaining the interaction between state of the physical world and mental states of actors involved in a communicative exchange. We have the goal of integrating physical world representations, such as space representation, physical co-presence of the actors and physical nature of the communication channel, with a cognitive account of communicative phenomena. We introduce the concepts of *scene*, *situation* and *scenery* for elaborating a theory for situated communication and give an account of the interaction between mental states involved in communication and the subjective representations of the state of the world.

1. Introduction

Communication and physical action are strictly connected. Since Austin's approach to Pragmatics based on speech-acts (Austin, 1962), the things one does through (not only) words, comprehension and generation of communication have been linked to the general framework of action. Conversely, the actions performed by an actor are better understood if considered as situated (Suchman, 1987; Clancey, 1998). Situations involve the physical world as well as the social world when other actors are present. The relationship between communication and action is complex. Actions performed in the physical social world are not necessarily communicative: in fact, they can either facilitate or impair communication itself, through a modification of the situational context. On the other hand, communication between actors can modify their intentions about performing actions in the physical world. Finally, the state of the physical world influences the possibility of performing actions and communicative acts.

Current theories on communication such as Relevance Theory (Sperber and Wilson, 1986) and Cognitive Pragmatics Theory (Airenti, Bara and Colombetti, 1993a; 1993b) deal with accurate descriptions of mental states and cognitive functions involved in communication. However, their applications to concrete situations is not straightforward because they do not give an account of how these mental states interact with the state of the physical world in order to produce the observed natural cases. In

particular, Cognitive Pragmatics, developing an intuition of Wittgenstein (1953), introduces the notion of behaviour game, namely a shared plan between the actors, but it gives no accounts of *how* the behaviour game is played in a concrete situation.

This work addresses the problem of explaining the interaction between the state of the physical world and the mental states of actors involved in a communicative exchange. We have the goal of integrating physical world representations, such as space representation, physical co-presence of the actors and physical nature of the communication channel, with a cognitive account of communicative phenomena. Our work is consistent with the perspective outlined by Clancey (1998) of shifting from an abstract and disembodied concept of cognition to a situated one. In one case, this approach amounts to exploiting the properties of abstract shared plans in communication, in order to enrich them with the features of concrete situated actions.

Our proposal is based on the novel concept of *scenery* that we define using the notion of a shared plan, namely a *behaviour game* in Cognitive Pragmatics terms. For an actor, to know the shared behaviour game is crucial in order to grasp the meaning of a communicative act. The *scenery* relates at the representational level context and at the level of behaviour games in terms of preconditions and possible actions.

The paper is organised as follows: Section 2 discusses situated communication in the framework of situated cognition, situated action and Cognitive Pragmatics Theory; Section 3 introduces the concepts of scene, situation, scenery and scenario; Section 4 proposes a cognitive account of situated communication and in the last Section we draw some conclusion.

2. Situated communication

Communication is obviously situated and it is situated in the environment, in the perception the participants have of the environment, and also in the mental representations they privately entertain. The Exs. 1-10 report a short fiction story that describes a long series of interactions between Alice, a professor, and Bob, a Ph.D student who aims to meet to discuss the draft of his thesis proposal. Alice and Bob communicate in a wide range of different physical environments (roads, corridors, office, elevator, cafeteria)

using different media (phone, e-mail), manipulating different objects (phones, handles, chairs, buttons, cups of coffee), meeting different people (maintenance people, cafeteria staff, a colleague). Moreover, during their interactions Alice and Bob are affected by the subjective perception they have of environments, media, objects and people, by their representations and finally by their representations of their own representations (meta-representations).

The process of communication may be theoretically described in terms of shared plans. This approach is assumed in the work of Airenti, Bara & Colombetti (1993a; 1993b) while shared plans have been proposed by Grosz & Kraus (1996). The theory of Cognitive Pragmatics is based on the idea that co-operation is the key element for the communicative interaction. It assumes that two people who communicate co-operate, and their actions are at least partly shared in order to reach a common goal. The plans by which two interacting people base their co-operation are called *behaviour games*. Plans can be seen as trees of intentions, where the leaves are specified either as terminal, precise actions, or as intentions made specific according to the context.

Behaviour games enable people to select the correct meanings to be assigned to the linguistic and extra-linguistic moves of each participant in a communicative exchange. Therefore, to understand the actor's meaning it is necessary to infer the behaviour game the actor is referring to.

Another concept adopted by Cognitive Pragmatics Theory, and which plays an important role, is *shared belief*, namely a belief that a single individual thinks of sharing with the person he is talking to. In symbols, a shared belief can be represented as follows:

$$SH_{AB} p$$

meaning that agents A and B share the belief p .

It is worth emphasising that shared belief is a subjective mental state. In other words, it may happen that A believes p to be shared by B and A, whereas B does not believe p to be shared by A and B. Shared beliefs are mental states which allow each actor to take for granted the sharing of a series of beliefs with his/her interlocutor and to use this background in order to add new beliefs. Shared belief is considered a primitive mental state of communication just like a private belief.

Given two actors, their relationship is defined as the set of playable games. The theory considers the relationship from both a static and dynamic point of view: In order to be playable a game also needs to be valid within the present state of the world. Validity refers to the whole context: physical, social and cognitive. However, the theory does not link directly relationship dynamics, validity conditions and state of the world.

From a situated perspective, the notion of communication as plan recognition and shared knowledge was targeted in the influential book by Suchman (1987). Suchman clarifies the status of plans as "an artifact of our reasoning about action, not as the generative mechanism of action"

(Suchman, 1987, p. 39), so plans do not determine actions in any strong sense. Suchman introduced the concept of situated action that describes the influence of the situation, environment included, on actions and communicative acts. However, adopting the situated cognition paradigm does not imply to accept that representations of the environment do not exist:

"Using the terms knowledge and representations synonymously, early situated cognition publications, including my own, say that 'representations are not stored in the brain'. A better formulation is that descriptions are not the only form of representation involved in cognition, and storage is the wrong metaphor for memory" (Clancey, 1998, p. 221).

The other form of non-descriptive representation, that Clancey refers to, emerges from the concept of direct perception (Gibson, 1979) supported by direct coupling between the agent and the world:

"In this interpretation of Gibson's idea of direct perception, directness means that the internal structures constitute and sustain their own space of configurations without *mediating 'stuff'* such as symbol strings representing the world. At this level of processing, outside stuff is neither brought inside directly nor mapped onto internal codes. Internal structures operate on their own changing properties. Higher levels of processing may *categorise* sensory configurations, but these are again only internal correspondences or relations between internal structures" (Clancey, 1998, p. 88).

However, the concept of situated communication introduced by Suchman emphasizes more the role of the whole set of actions performed by the actors as a situation or context for the conversational exchange, than the environment itself:

"When one takes situated language as the subject matter, however, the definition of the field must necessarily shift to communication under naturally occurring circumstances. And when one moves back far enough from the utterances of the speaker to bring the listener into view as well, it appears that much in the actual construction of situated language that has been taken to reflect problems of speaker performance, instead reflects speaker competence in responding to cues provided by the listener" (Suchman, 1987, p. 71).

Neither the shared-plan approach to communication presented above, nor the Suchman's notion of situated language are completely situated. The shared-plan approach follows the indications of a situated language provided by Suchman without considering the actions as situated or adopting her purely constructive notion of plan. The level of description is purely representational and, neither the environment nor the representations the partners have of the environment, are taken into account. On the other hand, Suchman takes into account the environment at the situated level but there is no trace of the environment in her representational notion of plan. The plan is a representation of actions that are in some sense unsituated. In other words,

both approaches lack in considering representations and meta-representations of the environment that are involved in communication and its interaction with actions.

For a complete theory of situated communication it is necessary to consider the interaction between environment and actions at all the levels: objective, directed perceived, representational and meta-representational. Considering environment and actions at each level guarantee the coherence with the situated cognition paradigm. Moreover, the approach should clarify some of the confusion generated by using the concept of "context" for all the levels.

Example

Alice is a professor. She is the tutor of Bob, a Ph.D student who is working on his thesis proposal.

```
1. >>From: Bob
   >>To: Alice
   >>Hello Alice,
   >>please find enclose the draft of my
   >>thesis proposal.
   >>Bob
   >
   >From: Alice
   >To: Bob
   >Hi Bob,
   >the basic ideas are rather good so the
   >revision will not take long.
   >what about a meeting on Tuesday at my
   >office at 10.00?
   >Alice
   >
   From: Bob
   To: Alice
   Hi Alice,
   See you then
   Bob
```

2. On Tuesday morning Bob is late for the meeting and he calls from his cell phone.
A: Hello
B: Hello it's Bob speaking. I'm late. Sorry, the traffic is heavy today
A: Don't worry.
3. Bob arrives and Alice is not in the office. The door is open. He waits in the corridor. Alice arrives and invites Bob to enter. They enter and Bob closes the door of the office. Alice re-opens it. They sit at the desk and they start to discuss.
4. After a while a man of the maintenance service knocks on the door. He enters saying that there is an electric failure in the building and he has to control the sockets of the room. While the man checks the room they keep on discussing.

5. The man goes away closing the door. Alice and Bob continue the discussion.
6. After a while the man comes back with a colleague saying that he has probably found the failure. They start to remove the floor tiles talking and making noise. Alice says: "Let's go to the cafeteria". Bob says: "Ok".
7. While they are going downstairs they keep on talking about the proposal but they get stuck in the elevator. Alice presses the alarm button. Bob calls security with the cell phone. While they are waiting they talk about how to get out of there and how to keep cool. Eventually the doors open.
8. They head towards the cafeteria. Alice turns left and Bob stops in the middle of the sidewalk. Alice says: "There is a shortcut to the cafeteria. We can pass through the Maths department". They keep on talking about the elevator.
9. At the cafeteria Alice meets a professor colleague. She introduces him to Bob. The professor asks Bob what is his subject and the professor asks a lot of details about his thesis. Alice says that they are going to work on it right now. The professor goes on asking questions and making suggestions. She takes her coffee cup and leads Bob to a small table with only two chairs. They starts to discuss again.
10. Two cups of coffee later, Alice and Bob agree on the improvements required by the draft and end the discussion.

3. Scene, situation, scenery and scenario

We propose four different concepts (scene, situation, scenery and scenario), in order to reflect the integrate influences of environment and of actions at objective, directed-perceived, representational and meta-representational levels respectively.

The terms we adopted -scene, situation, scenery and scenario- require a justification with respect to their usual meaning. We adopted situation ("relative position or combination of circumstances at a certain moment" Marriem-Webster) in the sense introduced in the situated cognition literature (Clancey, 1998). The usual meaning of scenario refers to an hypothetical, possibly simulated, state of affairs ("an account or synopsis of a possible course of action or events" Marriem-Webster) that the reason why we reserved the word for the meta-representational level. The common-sense meaning of scene appears more concrete and real ("the place of an occurrence or action" Marriem-Webster) and we reserved it for the more objective level. Finally and in contrast with scene, we adopted scenery for giving emphasis to the representational level ("the painted scenes or hangings and accessories used on a theater stage" Marriem-Webster).

In particular, scene considers the world and its affordances. Situation considers the directly perceived world and the possible actions. Scenery considers the represented world and the plans, and finally scenario considers the meta-represented scenery and the simulated executions of plans. The last three levels roughly correspond, using Clancey terms, to structural coupling, categorical reference and symbolic interpretation (Clancey, 1998, p. 317).

A *scene* is a state of the world equipped with a set of affordances. For example, a scene can be A's kitchen and its affordances for cooking, eating, drinking, washing. From an objective point of view, given the state of the physical world, the state provides an affordance for an action if there exists an actor that can execute it in that state.

A *situation* is the direct perception that an actor has of a scene. Namely, a situation is the subjective "representation" produced by an actor A of a state of the physical world and of the actions that are possible from the point of view of an actor A. For example: A in A's kitchen perceives the room and the possibility of drinking from the tap. This means that the actor has a functional "representation" of the world that can include mental states. If the world includes mental states the situation can be perceived as shared. Note that a shared situation is not a situation in the shared knowledge but a situation that is directly perceived as shared. For example: A in A's kitchen perceives B in the room and the possibility for both of drinking from the tap.

Giving the affordances of a scene the possibility of an action will be perceived by an actor depending on her own experience of the physical world. Moreover, the possible actions from the point of view of an actor can be the result of complex processes involving, goals, plans, motivations, self-esteem, self-deceit and, perception of self, of the others and of self-in-the-world, with the relevant possible distortions.

A *scenery* is a subjective representation produced by an actor A of a state of the world and of a set of plans that it is possible to execute within the world. Given a state of the world, a plan is possible if: (i) the represented state of the world verifies the preconditions of at least one plan, (ii) the moves of the plan correspond to possible actions in the scene. The plan is said to be executable within the scenery and the scenery is said to host the plan.

For example: A retains {KITCHEN} as a scenery for the private plan [BREWING COFFEE]. An attributed scenery is a scenery attributed to another actor. For example: A entertains {KITCHEN} as attributed to B and as a scenery for the private plan [BREWING COFFEE]. A shared scenery is a scenery within the space of the shared knowledge, and a shared scenery can host private or shared plans. For example: A entertains {KITCHEN} as shared between A and B and as a scenery for the private plan [BREWING COFFEE]; For example: A entertains {KITCHEN} as shared by A and B and as a scenery for the plan shared by A and B [COOKING PASTA TOGETHER]. Finally, a shared plan can be executable in a non-shared scenery. For example: If only A knows that there is pasta in his kitchen, A entertains {A's KITCHEN} as a scenery for the plan shared by A and B [COOKING PASTA TOGETHER].

A *scenario* is a subjective representation produced by an actor A that, possibly among other things, represents a scenery. For example: A entertains |B in A's KITCHEN| as a scenario representing B who entertains {KITCHEN} as a scenery for the private plan [BREWING COFFEE] and for the shared plan [COOKING PASTA TOGETHER]. A scenario can be a rather complex representation, possibly counterfactual or dynamic. In this sense our definition is consistent with the usual meaning of a hypothetical situation.

It is beyond our present goal to show how different approaches to context fit into this framework, but it is relevant to show how each concept can be considered a sort of "context" for actions or communicative acts. *Scene* can be considered as the context in an objective sense (e.g. the room the reader is in and its affordance for reading, writing etc.). *Situation* is the perceived context (e.g. the perception of the room the reader has now, while acting, namely reading), the here and now. *Scenery* emphasize the role of representation (e.g. a representation of the room the reader have or had and of the fact that there it is possible to read a paper). Finally *scenario* is related to context in the sense of encapsulable representations (e.g. the representation the reader had while thinking in the previous two examples). Our approach is consistent with the pragmatic approach to the relationship between context and relevance proposed by Ekbja & Maguitman (2001). Earlier cognitive pragmatics accounts of context (Bara and Bucciarelli, 1998) concentrated on the role of mental states and shared knowledge in the comprehension of a communicative act (Blanzieri and Bucciarelli, 1996a; 1996b).

4. A Theory for Situated Communication

In this section we use the concepts of *scene*, *situation* and *scenery* for elaborating a theory for situated communication. The aim of the theory is to give an account of the interaction between mental states involved in communication and the subjective representations of the state of the world.

The basic assumption is that from a cognitive point of view the three levels we hypothesize co-exist and co-operate. We assume that during situated communication the actors experience a flow of situations and each of these situations inform their actions. We also assume that representations like plans and sceneries can be mentally constructed as private, shared or attributed. Finally, the actor can entertain complex meta-representations (scenarios) involving sceneries. From an objective point of view the actors executes actions on a particular scene that can be perceived by the actors in different subjective situations and represented in different subjective sceneries.

What is relevant is the relation of the scenery with the shared-plans in terms of preconditions and possible moves. For example, given an actor like Alice in the Ex.1-10, her representation of her office in a University department {OFFICE} is a scenery for the plan [TUTORING SESSION], that has its preconditions verified and its moves are possible. Both {OFFICE} and [TUTORING SESSION] are shared between Bob and herself.

The scenery represents a state of the world including the communication channel. In Ex. 1 Alice and Bob communicate by e-mail and in Ex. 2 by phone. In both cases the scenery can include the remote presence of the actors and, in the case of e-mail, the asynchronous access to the messages.

It is worth noting that in a situated perspective any attempt to produce a representation of a situation, produces a scenery or a scenario. In fact, a situation is a direct perception, not a representation. In Ex. 2 we can only suppose the shared situation Alice perceives during the phone call. It will probably include Bob, the physical world Alice perceives through the phone and actions such as talking or listening. But Bob is stuck in the traffic so he has a private situation that includes himself facing a traffic jam with waiting or walking as possible actions. In any case in the attempt of representing the situation of the other agent, each actor entertains and attributes sceneries.

A *situation* is subjective, so it can change depending on whether a change in the scene occurs or not. A change of the scene produces a change of the *situation* if the actor perceives it. In Ex. 7 Alice and Bob realise they are stuck in the elevator and that changes their *situation*. A scene can change for external reasons or by means of an action performed by the actor or by the partner. In Ex. 7 the elevator stops for an external reason whereas Alice and Bob perform two actions (press the alarm button and call security) that changes the scene.

Scenery are subjective, hence they can be unrelated to the real scene. For instance, in Ex. 8 Alice attributes to Bob a scenery of the University that does not include the shortcut and using-the-shortcut as a possible action. Obviously, sceneries may also be private representations, permitting non-standard communication such as irony or deceit. In Ex. 2 Bob could lie about the traffic and have a private scenery that differs from the supposedly shared scenery he proposes to Alice. Being a representation, the scenery can also change by means of a communicative act without any change in the scene. In Ex. 8 Alice informs Bob that there is a shortcut, information which changes his scenery {UNIVERSITY}. Finally, a scenery change can be a goal of a behaviour game. In Ex. 6 Alice and Bob start to play a behaviour game aimed to produce the scenery {THE TABLE AT THE CAFETERIA}.

A scenery hosts different plans, and conversely a plan is executable in different sceneries. For example, {SCIENTIFIC DISCUSSION} and {TUTORING SESSION} are shared plans playable in the scenery {OFFICE}. Other sceneries like for instance {THE TABLE AT THE CAFETERIA} can host some of those shared plans. A shared plan is in principle compatible with more than one scenery. Thus, a change in the scenery does affect the game, which normally will develop within the constraints of the new scenery. In Ex. 6 Alice and Bob consider {TUTORING SESSION} as playable in both {THE TABLE OF THE CAFETERIA} and {OFFICE}. A scenery is subjective, so different actors can consider different games as playable in a scenery. A more formal professor, for example, can consider

[TUTORING SESSION] not playable at {THE TABLE OF THE CAFETERIA}.

In some cases a game may be played only in a specific scenery (e.g. trial in court); in other cases a game is incompatible with a scenery, hence if the scenery is activated, the game will end (e.g. smoking in a high-school toilet is interrupted by the presence of the supervisor). A change of the scenery closes the game only if the new scenery does not host the game. In Ex. 4 Alice and Bob continue to play [TUTORING SESSION] after the entrance of another actor changed the scenery from {OFFICE} to {OFFICE WITH MAINTANANCE GUY}. The new scenery hosts the game so the actors can continue to play. This is the case also in Ex. 5 where the scenery {OFFICE WITH MAINTANANCE GUYS} has changed the scenery {OFFICE}. On the contrary, the modification of the scenery {OFFICE} to the scenery {OFFICE WITH MAINTANANCE GUYS} in the Ex. 6 interrupts [TUTORING SESSION].

The actors, by modifying the partners' sceneries, shape their relationship. To settle the validity conditions of a behaviour game, is an implicit way of controlling the relation between agents. Actor A makes possible for herself and B to engage in game [G], by guaranteeing an adequate scenery. In fact, proposing the scenery for a game amounts to bidding that game (e.g. driving home a potential sexual partner). In Ex. 9 Alice chooses a table that modifies the shared scenery with the annoying professor in a way that prevents the playability of a game {THREE PEOPLE DISCUSSION}. The dynamic of the relationship produces effects in the long term, also affecting the basic relationship. In Ex. 3 the actions of opening or closing the door change the scenery dramatically. Actors modify the sceneries by means of actions that can be communicative acts, as noted in Section 3.

Given the co-presence of more than two agents, for each agent the third one can be part of the scenery, or can be involved in some behaviour game. In Ex. 4 and Ex. 6, the maintenance people are part of the modification of the {OFFICE} in a very natural way. In Ex. 9, the annoying professor tries to play [THREE PEOPLE DISCUSSION] in the scenery {CAFETERIA}. Alice changes the scenery to {THE TABLE OF THE CAFETERIA} that does not host [THREE PEOPLE DISCUSSION] and the game is closed. The professor does not join Alice and Bob and so he is not even part of the scenery anymore.

In order to understand the kind of phenomena our theory accounts for, it is interesting to note that a communication exchange produces actions that are either moves of the shared-plan or actions aimed to construct, maintain or modify the shared scenery. A shared-plan theory such as Cognitive Pragmatics accounts only for the changes of the scenery produced by the execution of the shared plan. In this case it would be possible to assume the existence of a general shared plan that gives an account of the whole sequence of actions. For example, the play of [TUTORING SESSION] in the scenery {THE TABLE AT THE CAFETERIA} could be considered as the execution of a more complex behavior game than [GOING TO A TABLE]

AT THE CAFETERIA FOR A TUTORING SESSION]. This operation is not plausible, in particular when the modification of the scenery is a consequence of a private plan or of an external cause that changed the scene. In fact, the idea of scenery prevents the explosion of the number of the behavior games.

5. Conclusions

We have presented a theory based on the concepts of scene, situation, scenery and scenario that gives an account of the interaction between mental states involved in communication and representations of a state of the world. The adoption of a situated cognition paradigm motivates the introduction of the concepts. Differently from precedent approaches to situated communication, we emphasize the role of the environment and of the representations agents retain of the environment.

The theory presented in this work refers to the cognitive process of two actors involved in a communicative exchange. Therefore, we do not consider the effects and phenomena produced by the interaction of three or more people. This requires further work in order to bridge the gap between cognitive processes involved in communication and phenomena studied by social psychology.

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